Available online at www.sciencedirect.com
SCIENCE DIRECT®

RENEWABLE
& SUSTAINABLE
ENERGY REVIEWS

PERGAMON Renewable and Sustainable Energy Reviews 7 (2003) 65–82
www.elsevier.com/locate/rser

UK renewable energy policy: a review

Peter M. Connor

Centre for Management under Regulation, Warwick Business School, Warwick University, Coventry, CV4 7AL, UK

Abstract

The paper addresses both historical and current UK policy relating to renewable energy. It discusses the stated aims of policy, and discusses to what extent policy has addressed these aims, and the level of success enjoyed with respect to each goal. The paper also addresses the context in which UK policy has developed, and the effects this has had on both the creation and employment of that policy. Finally, it comments on the likely future direction of policy in the UK.

Contents

1364-0321/03/$ - see front matter © 2003 Elsevier Science Ltd. All rights reserved.
doi:10.1016/S1364-0321(02)00054-0

1. Introduction

The United Kingdom's history and actions with regard to the development of renewable energy capacity provide a rich study in novelty and contradiction. The country has some of the best renewable energy resources available in Europe. It has the greatest wind resource of any European nation, most notably in Scotland [1]. Its long coastline offers ample opportunities for the development of wave, tidal and tidal stream technology and with one of the most efficient farming industries in the world; significant potential for exploitation of biomass also exists. This wealth of renewable resources has had strong competition for market share with the UK's rich reserves of oil, coal and gas, and historically has also lost out badly to the nuclear industry in terms of financial support, both with regard to direct subsidy and R&D funding [2,3].

Whilst the UK has made relatively well funded policy commitments to increasing its renewable energy capacity throughout the 1990s, it would still be hard to argue with the European Renewable Energy Study description of renewable resources 'playing an almost negligible role in the United Kingdom's energy balance' [4]. Since that 1994 report the UK's efforts have seen it rise only from 15th to 14th by 2002, on a list ranking the 15 EU countries on the fraction of energy they obtain from renewable sources. Production amounts to only 3% of total primary energy use in the UK, with 46% of this figure coming from hydropower [5b]. The reasons for this low figure can be broken down into a number of categories, including problems with planning regulations, poorly thought out support mechanisms and a general lack of political will. This paper will assess how various aspects of policy have impacted on the development of renewable energy resources in the UK. It will further discuss the radical changes to policy which are being prepared for application in 2002 and beyond.

2. Policy goals

The basis for UK renewable energy policy was laid down in Energy Paper 55, entitled Renewable Energy In the UK: The Way Forward, and published by the UK's Department of Energy [6]. The stated aims of policy were to;

- Stimulate the full economic exploitation of alternative energy resources in the UK;
- Establish and develop options for the future;
- Encourage UK industry to develop capabilities for the domestic and export markets.

These policy goals were reiterated in Energy Paper 60 (Renewable Energy Advis-

ory Group: Report to the President of the Board of Trade) [7], and then expanded upon in Energy Paper 62 (New and Renewable Energy: Future Prospects for the UK) to—albeit implicitly—place greater emphasis on environmental benefits, and to acknowledge the barriers to increased installation [7]. Finally, alongside the announcement in 2000 of the government's intention to adopt the renewables obligation [8] came the introduction of some changes to the key aims. These policy objectives form the current basis for policy;

- To assist the UK to meet national and international targets for the reduction of emissions including greenhouse gases;
- To help provide secure, diverse, sustainable and competitive energy supplies;
- To assist the UK renewables industry to become competitive in home and export markets and, in doing so, provide employment;To make a contribution to rural development. [6]

The new additions in 2000 relate to the environmental benefits already implicit in the use of the technology, and highlight the potential benefits specific to the likely rural siting of some technologies, a benefit with political advantages at the national level in the UK relating to rural issues outside renewable energy. It is evident that there are a number of stated objectives of UK renewable policy that have remained relatively constant. However, it is possible to make significant distinctions between the efforts made in supporting different aims. Comparing efforts in an international context, the UK has performed poorly with respect to most of its policy goals when contrasted with nations such as Denmark, Germany and Spain, all of which it outdoes in terms of natural resources, and with which it was competing in terms of funding in the early 1980s.

The UK government has also set a number of targets for renewable energy installation. In 1989, a target of 600 MW of 'declared net capacity' (dnc) to be in place by 2000 was announced. The release of the Government's White Paper on the Environment in 1990 saw this target raised to 1000 MW [9], and the Coal Review White Paper of 1993 saw it raised once again to 1500 MW dnc, to be online by 2000 [10]. The last of these proved to be too ambitious, largely due to an overestimation of success rates for NFFO projects.

The change in mechanisms in 2001 saw a new target, with the Renewable Obligation Statutory Consultation Document setting a target for renewables of 10% of all UK electricity generation by 2010, with further specific targets of 3% by March 2003 and 10.4% by March 2011 [11]. The recent Energy Review carried out by the Performance and Innovation Unit of the Cabinet Office suggested that a further target of 20% renewables by 2020 should also be set, though this has yet to be accepted as Government policy [12].

3. Historical background to UK policy and technology choices

This section describes both historical UK renewable energy policy mechanisms, and the technologies that have been favoured by these mechanisms, along with discussion of why these technologies were chosen, and why others were not.

Whilst having provided prior support for the support of R&D efforts in renewable energy, significant efforts in providing UK policy on developing their potential can be traced to the oil crises of the 1970s, as with the efforts of so many of its competitors.

Elliott provides an extensive overview of renewable energy R&D funding in the UK up the late 1980s, and the underlying policy basis for it [2]. Elliott records that wave energy came to be the most favoured of the new renewable energy technologies in the late 1970s and received considerable government support on this basis. This was to change following a 1982 review by the Advisory Council on Research and Development for fuel and power (ACORD), along with a report from the Energy Technology Support Unit (ETSU) [13]. This led to the reassessment of wave as unlikely ever to achieve a sufficiently low price to make it economically viable. This was re-emphasised in ACORD's next report in 1986, which suggested that wave energy was never likely to produce power at less than 9p/kWh. Elliott notes that Norwegian research at the time was suggesting a price of 3p/kWh. Interestingly, the ACORD review has come under re-analysis in recent years, and has been condemned as likely to have contained errors which may have caused future wave prices to have been miscalculated by an order of magnitude. Obviously, it is impossible to know what the results would have been had this mistake not occurred. The head of the DTI's Sustainable Energy Policy Unit admitted in March 2001 that it has been a mistake to curtail the UK's efforts in wave energy technology development in 1994 [14].

The ACORD report also led to a reversal in wind's fortunes. Wind had initially been classified as one of the technologies least likely to develop to an economically viable stage and was thus provided with only a low level of funding. ACORD support of wind led to favourable government policy and funding for R,D&D, though the government stood firmly against providing direct financial grant aid to try to move the technology from the demonstration phase towards being fully commercial. This policy of eschewing grants was to remain intact up to the 2001 announcement of £40 million to support a limited number of offshore wind developments and the expansion of biofuel use. Further grants have been announced for the support of both offshore wind and increased bio-energy use as detailed later in this paper.

The focus on developing wind technology by a range of countries, including the USA, Germany, Denmark, Sweden and the Netherlands, also provided considerable help in moving wind energy back on to the agenda in the UK. The result was that a number of development plans began to be mooted in the UK. These tended to be led by private consortia with the support of the Department of Energy (DoE) and the involvement of the Central Electricity Generating Board (CEGB). Elliott suggests that the DoE regarded these undertakings as demonstration projects, with the presumption that they would lead to large-scale installations developed by the private sector once the technology had been proven [2]. This expansion did not occur. Whilst there are a number of reasons for this failure, including poor economic potential and inadequate political support, it also highlights the way in which the UK has perhaps relied on the expectation of early entry of private capital as the basis for the maturation of new renewable energy technologies. In comparison, those nations that have

provided more extensive public support have proved more successful in both the creation of new industries and in the deployment of new RET capacity.

The failure to attract private capital is also reflected in the comparatively poor support of R&D funding for renewable energy technology in the UK. From the late 1980s, UK funding was reduced on the basis that public funding would be steadily replaced with private funding, as the technology became commercial. Whilst prior to electricity privatisation and the introduction of a new support mechanism, the Non-Fossil Fuel Obligation (NFFO), expectations for the level of private funding flowing in to renewable technology were not being met, the problem became more pronounced with the early rounds of the NFFO. The results of this were that available private capital tended to go into financing new developments rather than the support of UK industry. Along with the inappropriate structure of the early rounds with regard to supporting UK industry, the result was the undermining of UK research efforts for new renewable energy technologies.

The NFFO was, in terms of RE support mechanisms, both novel and innovative, whilst it can be said to have achieved some of its goals, with regard to many of the UK's policy goals it was not particularly successful. At this stage it should be made clear that RE policy often applies to specific parts of the UK, rather than the state as a whole. The NFFO, for example, was the mechanism for England and Wales, and similar mechanisms, the Scottish Renewables Obligation (SRO) and NI-NFFO existed in Scotland and Northern Ireland respectively.

The NFFO required public electricity suppliers to make orders for sufficient non-fossil fuel generated electricity, as defined by the relevant Secretary or Minister of State, with the responsibility generally lying with a Minister at the Department of Trade and Industry. From 1989 until the bulk of the UK nuclear sector passed into private hands in 1996, this included all the electricity generated by nuclear power stations in the UK. It also includes a small amount of renewable capacity as specified in orders made by the relevant Minister. The subsidy, as specified in the 1989 Act, was provided through the Fossil Fuel Levy (FFL). This levy was placed on all sales of electricity generated from fossil fuel sources, with costs being passed on to all electrical consumers. The FFL and disbursement of all levied funds was the responsibility of the Non-Fossil Purchasing Agency (NFPA). The FFL amounted to an addition of around 10% to electricity bills up to 1996 though the vast majority of this money went to subsidise nuclear power. Renewables received 0.5% of the total levied in 1990–91, increasing to 8% in 1994–95, amounting to £6M out of £1175M in 1990–91, and rising to £96M out of £1204M in 1994–95 [15].

Whilst still a useful sum for the burgeoning industry, the bundling of renewables with nuclear made them vulnerable to the limitations which the EC placed on the length of time that it was felt was fair for the UK consumer to subsidise the nuclear industry. The EC ruled that the subsidy could only be provided from 1990–1998, severely limiting the availability of funding for new renewable projects, and leading to the payment of high prices in order for projects to approach economic viability. This was particularly true in the second round of the NFFO, NFFO-2, where contracts where only available from 1992–1998, including construction time. The unbundling of renewables from nuclear in 1996 meant that contract periods could be extended

to 15 years, and that a grace period could be added so that projects were able to claim for generation across the full period. This period was set at four years for NFFO-3, rising to five years subsequently.

The use of the NFFO as the central tool for achieving policy goals and capacity targets in the UK had a number of drawbacks. The short term nature of the first two rounds meant that projects had to be rushed through, leading to a backlash from parties concerned that it would mean a too rapid transformation in the UK landscape. The immediate demand for turbine equipment also meant that UK manufacturers were unable to meet orders and developers were forced to purchase from overseas, thus undermining the potential for the establishment of a competitive UK industry—one of the supposed long-term goals of UK RE policy, as set out above.

4. Current status

4.1. The central mechanism—the renewables obligation

This section will cover the current status of UK policy, with regard to the effects of older policy that is still impacting on UK renewables development, and detailing newer policy, along with a discussion of the likely impacts that this might have on the increased use of RET.

The end of 2001 saw the announcement of a wide range of new instruments aimed at revitalising the UK's efforts regarding renewable energy. At the time of writing however, not all of these have reached the statute books and begun to have an impact in real terms. The commencement of the RO has finally moved the UK away from its position of being between policies, at least with respect to the central mechanisms aimed at stimulating growth in capacity, but it remains to be seen what the impacts of both the RO and the various other newly announced policy instruments will be. The effects of the last three rounds of the NFFO (NFFO-3, 4 and 5) will continue to be felt, as the Utilities Act 2000 enabled saving arrangements for projects constructed under contracts awarded in these rounds [16]. These arrangements saw the NFPA draw up contracts with generators effectively mimicking those originally signed under the NFFO. These were then transferred to the supply successors to the Public Electricity Suppliers (PES) following the licence split under the New Electricity Trading Arrangements (NETA). Payments relating to contracts originally awarded as NFFO projects are eligible up to 2018, on the basis of the 1998 award date, with a five-year preparation period followed by 15 years of payment.

Current plans for future policy in the UK centre on achieving a target of 10% of all electrical generation from renewable energy sources by 2010. The central mechanism aimed at achieving this end is the newly introduced Renewables Obligation (RO). The RO is an example of a renewable portfolio standard (RPS) mechanism, a mechanism devised in the mid-1990s by the Union of Concerned Scientists and the American Wind Energy Association [17]. The central underpinnings of such a mechanism are to try to maximise the level of competition within the support mechanism, whilst trying to guarantee a minimum level of installation of new capacity.

In theory, the RO acts to place an obligation on consumers to have a certain percentage of their electricity mix derived from renewable sources. In practice, it is met by the utilities supplying these consumers. The RO will again apply only in England and Wales, with a Renewables Obligation (Scotland) replacing the SRO, and also coming in to operation on April 1st 2002. At time of writing no new mechanism has been announced for Northern Ireland.

The UK Government has set a number of targets for renewable energy installation, the majority of which it intends to achieve through the operation of the RO, though some other mechanisms are also expected to play a part. The yearly target levels for the RO are shown in Table 1, below;

The RO mechanism is quite simple, perhaps, it might even be argued, too simple. Within the RO, each licensed electricity supplier in the UK is subject to “a legal obligation to supply a specified proportion of their electricity supplies from renewable energy sources to their customers in Great Britain” [16]. Suppliers need to offer proof of their compliance to the regulator, OFGEM. They have a choice about how they fulfil the obligation.

Suppliers demonstrate their compliance with the RO through the production of 1 MWh Renewables Obligations Certificates (ROCs). These can be earned through the supply of renewable energy purchased from generators, or alternatively can be purchased independently of their energy use. ROCs are individually numbered and carry information as to the energy generating station and type, and the time period in which the corresponding electricity was generated. Suppliers are also able to sell any excess ROCs to other suppliers. Obligations run over a one year period from April 1st to March 31st. Compliance for each one-year period must be demonstrated by the 1st October immediately following this. Compliance can be made through the presentation of sufficient ROCs or through the payment of a buyout price where a company has not been able to secure sufficient ROCs to meet their obligation or where they chose not to do so. The regulating body, the Office of Gas and Electricity

Table 1
[11]

Period	Estimated sales by licensed suppliers in GB TWh	Total obliqation (GB) TWh	Total obliqation as 9% of sales (GB) %
2001/2002	310.9		
2002/2003	313.6	9.4	3.0
2003/2004	316.2	13.5	4.3
2004/2005	318.7	15.6	4.9
2005/2006	320.6	17.7	5.5
2006/2007	321.4	21.5	6.7
2007/2008	322.2	25.4	7.9
2008/2009	323.0	29.4	9.1
2009/2010	323.8	31.5	9.7
2010/2011	324.3	33.6	10.4
2011/2012–2026/2027			10.4

Markets (OFGEM), administers compliance. Failure to comply with the RO will render electricity suppliers subject to the imposition of financial penalties in line with Section 25 of the 1989 Electricity Act [18]. Those funds accruing to OFGEM by suppliers paying the buyout price in order to meet full compliance are placed into a central fund which is then redistributed to suppliers in relation to the number of ROCs presented by the supplier. That is, if a supplier presents 5% of the total ROCs presented in each yearly period of compliance, they will receive 5% of the total buyout proceeds. Thus an additional economic stimulus is provided to companies to meet the obligation through generation and the earning of ROCs, rather than through meeting the buyout price.

The buyout price has been set at 3.0p/kWh (£30/MWh) for the first compliance period. The figure will be increased in line with the Retail Price Index (RPI) on an annual basis. The figure effectively provides a ceiling for the amount that a supply company will pay out for electricity from renewable sources. The cap is aimed at limiting the costs to be passed on to the consumer. The other effect is to place a limit on those technologies that are likely to be stimulated by the RO mechanism, with more expensive technologies effectively being priced out of the mechanism. Technologies outside the mechanism thus also risk being rendered permanently uncompetitive through lack of market access. It is possible that introducing separate obligations for different technologies would address this problem, but this option was specifically rejected by the UK government on the grounds that it would make the mechanism too rigid and would be ‘contrary to the market-led basis of the obligation’ [11].

The RO is intended by the current Labour administration to be the central support mechanism for renewable over a 25-year period. However, whilst the long-term security of availability of support is vital to any mechanism intended to assure increases in renewable energy, merely establishing that a mechanism is intended to last over an extended period is no guarantee that it will do so. Firstly, there is considerable potential for such a mechanism to be altered due to future political considerations, both in terms of ideology and with regard to the results that the mechanism produces. Secondly, even if the existence of the mechanism can be secured in the long term through political agreement, this provides no guarantees with regard to establishing security in terms of long-term contracts for electrical generation from renewable sources. The end result of this is likely to be that it will be made more difficult to secure financing for renewable energy projects under the RO. The follow-on effect will likely be that only larger companies, with the wherewithal to provide their own financing, will be in a position to make the long term investments necessary to reap the rewards of the RO.

The Renewables Obligation, in the words of the then Secretary of State for Trade and Industry, Stephen Byers, is intended as a policy “of action, not of direct intervention” [16]. Whilst the basis of the mechanism in attempting to drive down prices whilst achieving increasing capacity goals by maximising competition justifies this comment, some of the other new policy mechanisms announced in the last few years are perhaps more interventionist in nature.

4.2. Additional support mechanisms

Considerable amounts of government funding have been committed to the development of renewable energy capacity in the UK since 2000. Announcements of various other programmes have followed. A DTI document published in July 2002 listed the following availability of funding;

- £18 million per annum for the Government's enhanced renewable energy research and development programme, available through the Department of Trade and Industry (DTI);
- £74 million support for offshore wind, with £64 million of this available through the DTI and the rest from National Lottery New Opportunities Fund (NOF);
- £30 million from the DTI and £36 million from the NOF for bioenergy capital grants, plus a further £29 million from DEFRA in the period up to 2002;
- A further £10 million for innovative PV schemes;
- £10 million for renewable use in the community from the DTI, plus up to £50 million from DEFRA aimed largely at increasing CHP usage;
- a £5 million fund for wave and tidal project demonstration;
- £4 million for utilities to investigate new metering and control technologies. [19a]

This funding clearly favours the increased use of offshore wind energy and of bio-energy. The funding for offshore wind was introduced in support of the announcement of the awarding of licences for 18 offshore wind farms around the coast of the UK, with a projected total capacity of 1.0–1.5 GW. The shift to supporting offshore wind can be regarded as a response to low development rates for onshore wind, largely as a result of barriers to obtaining planning permission. The Government intends to support offshore development further through the creation of a 'one-stop' process for obtaining planning permission from those bodies with responsibility for UK waters. It is hoped that this will ensure that offshore developments are approved with the minimum of problems.

The increased use of bio-fuels is also seen as essential to the UK meeting its targets for increased renewable energy use. Regional targets for increases in renewable energy rely heavily on this increased use, from what is currently a very low base. A 2002 report to the DTI and DTLR, 'Regional Renewable Energy Assessments' suggested that landfill gas, energy from biodegradable waste and from biomass could constitute almost half of UK renewable energy by 2010, if targets are met [20].

Outside their specific application to offshore wind and to bio-fuels, the use of grants to support renewable energy can be regarded as an interesting development in UK RE policy. The use of grants has been eschewed in recent RE policy history, largely, it would appear, on the basis that they represent too great an interference with the operation of the market. That this is beginning to change may suggest the admission that market mechanisms—even near-market mechanisms—alone will not achieve the increases in the use of new and expensive technology that are required to meet the UK's commitments to increased capacity.

A further policy development with implication for RET development is the introduction of a Carbon Trust. This initiative is funded through the recycling of a small part of the funds raised from the Climate Change Levy (CCL), a tax of 0.43p/kWh placed on electricity sales to industrial consumers. The Trust is a not-for-profit company limited by guarantee, established by the UK Government in 2001. Its aims, as defined by Prime Minister Tony Blair, are to "Take the lead on low carbon technology and innovation in this country, and put Britain in the lead internationally" [21].

The Carbon Trust has three main programmes, but the one most directly relevant to renewables is the Low Carbon Innovation Programme (LCIP). The LCIP aims to be a principle mechanism for "developing new low carbon technologies over the short, medium and long term". The programme hopes to achieve the removal of barriers to a wide range of technologies at all stages of maturity, through the application of funding specific to the particular problems they are respectively likely to encounter. The initial proposals for the Trust envisioned that renewables would form a central facet of the Trust's work. While this vision has been weakened to some extent, RET's have the potential to receive a considerable fraction of the funding available to the LCIP, currently around £25 million p.a., but with the potential to increase substantially dependent on the level of success of the Carbon Trust. Notably, the Chief Executive of the Trust, Tom Delay, has suggested that the Trust is likely to focus on only three or four RET's rather than risk diluting efforts by supporting the full range [22]. The director of the LCIP, Peter Shortt, has also suggested that the programme will only provide support where none is available from other sources within UK policy programmes, and thus for example, the Trust will not be supporting offshore wind [23].

5. Current technology choices

As has already been discussed, the UK has not been very successful in the choices it has made for the development of RETs. Whilst its focus and failure with regard to large-scale wind energy projects was matched by equally unsuccessful efforts from other nations, the UK has made a number of additional poor policy choices. The failure of large wind turbines was followed with a recommendation to the Department of Trade and Industry that the technology was amongst the least likely to become economic. This error was compounded with the abandonment of wave energy research, as detailed above. The UK has also been outstripped in researching the increased use of bio-energy, with continued failures to establish the relevant technology as a significant energy contributor in the UK.

It can be argued that the technologies that have established capacity in the UK have done so only after they have become economic elsewhere. Whilst it might be argued that this has a positive side in that it places the costs and risks of investment outside the UK, it also means the UK is not in a position to exploit many of the positive economic and social benefits that come with fully successful exploitation of new RETs.

Assessments of the potential for the use of renewable energy use carried out at the regional level in the UK, resulted in a number of projections for the various RET's. These were summarised into Table 2 below.

Clearly, onshore wind remains the bulk technology of choice, with biomass projected to move into second place. It should be noted that whilst the installed capacity for wind appears much greater than that for biomass, the greater availability of biomass generators means their actual output is higher. It is perhaps worth bearing in mind that electrical generation from biomass, as with a number of the technologies on this list, is largely unproven in the UK context. Offshore wind also falls into this category, though it can be argued that in the large part it is merely the offshore use of proven wind energy technology, and not a huge change in itself.

The report on regional targets for renewables points out that the projections for each of the technologies is dependent on them achieving significant cost reductions such that they become economically attractive to purchasers. Clearly, whether this occurs will relate to a number of factors including world-wide development of the technologies, but also to UK renewable energy policy as they specifically affect the individual technologies.

The RO is likely to have a number of important implications for those technologies that are developed in the UK. The use of a price cap will effectively act to divide all RETs into two groups, those that can deliver below the price cap, and those which cannot. Those that can deliver—or at least those that can deliver most cheaply—will be able to obtain contracts and the technology should reduce in price. Those which are as yet unable to achieve a competitive price will not be supported by the RO, and without this advantage face the possibility of becoming slowly less competitive and falling further behind in terms of competitiveness. It is in these areas where the use of market or near-market instruments are perhaps rendered less effective, requir-

Table 2
Projected Renewable Electricity Generation in 2010 [20]

	Low (Mwe)	Low (TWh)	% of RO	High (Mwe)	High (TWh)	% of RO
Onshore wind	3563	9.4	29%	4542	11.9	37%
Offshore wind	751	2.6	8%	1483	5.2	16%
Marine technology	1	0.0	0%	72	0.2	1%
Landfill gas	608	4.8	15%	615	4.8	15%
Biomass	471	3.5	11%	874	6.5	20%
Anaerobic digestion	74	0.6	2%	87	0.6	2%
Small hydro	92	0.3	1%	111	0.4	1%
PV	35	0.1	0%	56	0.1	0%
Energy from biodegradable waste	4	0.0	0%	329	2.4	8%
Total	5598	21.3	66%	8170	32.3	100%
Scotland offshore[a]				1000	3.5	

[a] This figure is not included in the regional assessments. It equates to 1 GW of offshore wind capacity built in Scotland.

ing greater government interference, and the use of additional policy mechanisms such as the provision of approximately £250 million in additional funding as detailed above, and the creation of the Carbon Trust.

6. Economics

Gauging the current economic state of renewable energy in the UK is currently a relatively difficult task. This may improve somewhat with the production of data resulting from the first operational year of the Renewables Obligation, which should become available at some point following April 2003, though it is likely to remain a complex issue for some time to come.

The current economic status of renewables owes more, however, to the NFFO. Table 3, below, represents data relating to various prices accepted for the various rounds of the NFFO.

Whilst the table suggests that the NFFO led to considerable reductions in the price of renewable energy, to some extent this representation is disingenuous. The biggest drop in price occurs between the second and third rounds of the NFFO. This drop was actually caused by changes in the nature of the NFFO, which removed 1998 as the final year in which subsidies could be made available to support renewables, and allowed them to be made available over 15 years. It also allowed a four—later five—

Table 3
NFFO prices [24]

Technology band	NFFO1 Cost-justification	NFFO2 Strike price (p/kWh)	NFFO3 Average price (p/kWh)	NFFO4 Average price (p/kWh)	NFFO5 Average price (p/kWh)
Wind	10.0	11.0	4.43	3.56	2.88
Wind sub-band	–	–	5.29	4.57	4.18
Hydro	7.5	6.0	4.46	4.25	4.08
Landfill gas	6.4	5.7	3.76	3.01	2.73
M&IW[a]	6.0	6.55	3.89	–	–
M&IW[b]	–	–	–	2.75	2.43
Sewage gas	6.0	5.9	–	–	–
EC&A&FW[c]	–	–	8.65	5.51	–
EC&A&FW[d]	–	5.9	5.07	–	–
EC&A&FW[e]	6.0	–	–	–	–
M&IW/CHP[f]	–	–	–	3.23	2.63
Total	7.0	7.2	4.35	3.46	2.71

[a] Municipal and industrial waste with mass burn technology.
[b] Municipal and industrial waste with fluidised bed technology.
[c] Energy crops and agricultural and forestry waste with gasification technology.
[d] Energy crops and agricultural and forestry waste with residual technologies.
[e] Energy crops and agricultural and forestry waste with anaerobic digestion.
[f] Municipal and industrial waste with combined heat and power.

year grace period before payments had to begin to allow the project time to be established. The longer payment period meant that the payments per kWh of production could be considerably less against the same purchasing of equipment, and the confirmed security of longer contracts allowed cheaper financing to be secured. Prices for the later rounds of the NFFO continued on a downward trend, though it is possible that this is also not truly reflective of the actual costs of development. Many projects have not come on line, either through rejection at the planning phase or because the decision has not been take forward by the developer. Further, the grace period for NFFO-5 only expires in 2003, so it is not yet possible to obtain final figures for price reductions achieved through the mechanism. Two factors may affect whether a project becomes economical and whether it is established at the end of this period, both related to the absence of any mechanism for penalising developers who decline to fulfil their successful bids. The first factor is that the grace period means that developers could bid with the projected expectation of reduced prices during the period, if the real reductions do not meet the projections, then projects will not become economic and will be cancelled.

The second possibility created by the absence of a penalty mechanism was that some developers may have been inclined to bid lower than was realistically feasible in order to deny their competitors the chance to capture a contract [24].

Whilst these problems can be regarded as negative economic impacts of the outgoing NFFO mechanism, there are a number of economic issues for renewable energy generation arising from current policy.

The most immediate economic complication for renewables in the UK stems from the New Electricity Trading Arrangements (NETA). Essentially, NETA is a mechanism for balancing the electricity supply market in the UK. However, the nature of the mechanism is such that is unfavourable to generators with less predictable outputs. The result has been a reduction in the price that renewable energy generators have been able to attract. Prices for wind have been quoted as having dropped by 30% after the introduction of NETA, with prices for CHP down by as much as 60%. Ofgem are currently seeking a solution to this problem based on a number of small generators banding together to try to make their combined output more saleable, and the DTI claims to be investigating ways to ease the barriers to such consolidation.

Another economic barrier to renewable energy, both in the UK and elsewhere, is presented by the failure of regulation to take into account the advantages presented by the more distributed nature of the generating technology. The positioning of renewable energy generating capacity in the grid system is such that it can offer advantages in terms of grid reinforcement that are currently not accounted for in the way in which transmission and distribution costs are calculated. The result of this is to effectively ignore some of the economic advantages of the technology and act to make it less cost effective, less desirable and thus less likely to be competitive. The DTI commissioned an Embedded Generation Working Group (EGWG) to investigate how this issue might be addressed. The EGWG reported its findings in 2001, though the Government has yet to act on the recommendations made [25].

The main economic impacts in the near future though, are likely to be those arising from the RO. Smith and Watson [5b] point out that the market for ROCs created

by the RO is, in theory, quite simple, as represented in Fig. 1. The inclusion of a buy-out price acts to limit the operation of the market. If the market for RE is low, (e.g. Line T_{mod}), then the price for ROCs will remain low (P_M). If the government acts to raise targets and thus increases demand, the price will climb. If the price climbs above a price defined by, but not equal to the buy-out price plus the potential return form the buy-out fund, plus any other factors which skew the price—for example, renewables exemption from the CCL—then suppliers will decline to purchase ROCs. Clearly this figure is highly variable, and some of the variables are difficult for suppliers to estimate for an extended period given the unpredictability of the buy-out fund.

The reality of the situation may vary radically from this simple model however, due to a number of complicating factors. The exclusion of hydro power from the obligation means that current supply is not going to meet demand in the initial periods of the RO. Demand is further pressured due to the exemption of renewables from the climate change levy of 0.43p/kWh which applies to most electrical generation in the UK. Watson calculates that ROCs are likely to have a value of 3.4–5.7p/kWh in 2002–2003 [26]. Whether this figure rises or falls is dependent on the rate with which new renewable generation is brought on-line. Of particular note is likely to be the nature of contracts between renewable electricity generators and supply companies as to how future costs and returns are likely to be split, an issue which will relate directly to the security of investment of any future RE development.

The perception of risk with regard to investment in renewables is likely to lead to some changes in those actors who will be capable of taking part in the sector. Lack of familiarity with the mechanism, alongside the increased perception of risk is likely to make it more difficult for small scale investors to gain access to capital. It is possible that investment will be limited to those large-scale developers who can provide their own capital.

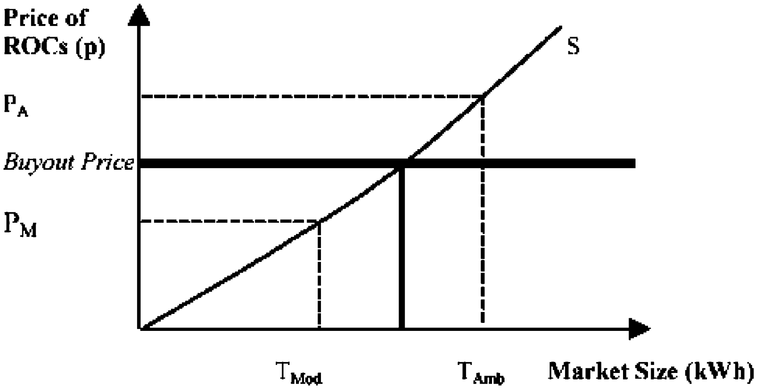


Fig. 1. An ideal market in renewables obligation certificates [5a].

7. Future projects

The major projects likely to dominate RE expansion in the UK in coming years are likely to be the 18 offshore wind projects proposed during 2001. The list of developers who successfully pre-qualified to obtain a lease of seabed was announced in April 2001. Whilst there is still some way to go before construction occurs, the sites have already met opposition. Most notably, this has come from the Ministry of Defence which claims that turbines would interfere with its ability to defend the UK, a problem which has not arisen in UK allies such as Germany, Denmark and Spain which each have considerable installed turbine capacity.

These may have the potential to be outdone for controversy, by suggested plans for major onshore wind developments, especially projects such as the large windfarm development proposed for the Isle of Lewis, should this move beyond the stage of simple suggestion. Even setting aside major projects such as that suggested for Lewis however, in order for regional and national targets for renewable energy to be met, it is going to be necessary for considerable expansion of wind energy to occur. Recent history would suggest that even comparatively small projects are liable to be met with considerable opposition.

The other major technology that is projected to increase rapidly in the UK if targets for renewable expansion are to be met is greater bio-energy exploitation. While individual projects are not likely to be on as significant a scale as with the offshore wind projects, the total energy to be generated in this way may be of comparable magnitude, at least if government targets are to be met. Clearly this will have a considerable impact on the rural environment of the UK; it may also require significant alteration to current UK and EU agricultural policies.

Another recently announced project is the establishment of a Marine Energy Test Centre at Stromness on Orkney, in the north of Scotland [27]. The Scottish Executive announced £400,000 of funding for the completion of a full site survey in mid-2001, and completion of the centre is expected before the end of 2002. The centre will carry out research on wave and tidal energy exploitation. The Orkney site is also linked with government backed research by the private company, Wavegen, into the use of wave energy. Wavegen are also collaborating with Scottish and Southern Plc, a major UK electricity supplier, in identifying sites for the establishment of wave power generating stations in the Western Isles of Scotland [19b].

Linked to the development of both wind and wave energy in Scotland, and a further potentially significant project, is that mooted by the current UK Energy Minister, Brian Wilson, for a subsea cable stretching from the Isle of Lewis in the north down the West Coast of the UK as far south as Merseyside. This could facilitate the transmission of electricity generated from renewable sources in Scotland and in offshore wind farms in the Irish Sea to more appropriate areas of electrical demand. A report was prepared detailing the likely costs of the project; consideration of its viability is currently under consideration by the relevant public bodies.

The eagerness on the part of the Scottish government may also be regarded as a signal of what appears to be a growing divide between attitudes to the establishment of new renewable energy projects in Scotland and Wales. While the Scottish Parlia-

ment seems highly disposed to encouraging increased investment and planning approval for new projects, with the expressed aim of capturing potential new manufacturing opportunities, the Welsh Assembly has been less welcoming, possibly regarding the preservation of the existing tourist industry as more important than the potential for new manufacturing capacity.

8. Future directions

The Renewables Obligation seems likely to stand as the central mechanism for supporting renewable energy in the UK for some time into the future, barring its total failure to produce increases in capacity. Its introduction by the Labour government ensures its favour with one side of the political divide, whilst its competitive nature ensures its appeal to the Conservative Party, thus rendering it unlikely to be changed in favour of another mechanism. The possibility remains for its removal on the grounds of its imposition of additional costs to the energy consumer, but at the time of writing Conservative environment policy is under review and no up-to-date opinion was available.

The implementation of the RO is at too early a stage to judge as regards its efficacy in achieving its stated goals, and thus as to whether it will provide effective regulation. RPS mechanisms have been known to produce results in terms of stimulating additional capacity when employed alongside other policy instruments, as with the variation currently being employed in Texas, though they have been slower to produce results in other US states. Their performance comparative to that of Feed-In Tariff mechanisms with regard to the specific policy goals of the adoptive state is less clear cut.

9. Relevant societies and organisations

Trade associations

British Wind Energy Association (BWEA), 26 Spring Street, London W2 1JA, UK.

Tel: +44-(0)207-402-7102; Fax: +44-(0)207-402-7107; e-mail: info@bwea.com

Web site: http://www.bwea.com

Hold a yearly conference.

Renewable Power Association (RPA), PO Box 2731, Lewes BN7 1LL.

Tel: 01273 472468; Fax: 01273 472468; e-mail: ghartnell@enterprise.net

Web site: http://www.r-p-a.org.uk/

British Biogen, Rear North Suite 7th Floor, 63-66 Hatton Garden, London, EC1N 8LE.

Tel: 020 7831 7222; Fax: 020 7831 7223; e-mail: info@britishbiogen.co.uk

Web site: http://www.britishbiogen.co.uk/links/contact.htm

The British Hydropower Association, Unit 12 Riverside Park, Station Road, Wimborne, Dorset, BH21 1QU.

Tel: +44 (0) 1202 886622; Fax: +44 (0) 1202 886609;

e-mail: bha@hydroplan.co.uk Web site: http://www.brit-hydro.cwc.net/

Environmental Services Association, 154 Buckingham Palace Road, London, SW1W 9TR.

Tel: 020 7824 8882; Fax: 020 7824 8753; e-mail: info@esauk.org Web site: http://www.esauk.org/

(Formerly Energy from Waste Association)

Biogas Association, PO Box 2731, Lewes, BN7 1LL.

Tel: 01273 472468; Fax: 01273 472468

Web site: http://www.biogas.org.uk/

Solar Trade Association, The National Energy Centre, Davy Avenue, Knowlhill, Milton Keynes, MK5 8NG.

Tel.: 01908 442290; Fax: 01908 0870 0529194;

e-mail: enquiries@solartradeassociation.org.uk

Web site: http://www.greenenergy.org.uk/sta/

The British Photovoltaic Association, Attn. Delphine Gadenne, Davy Avenue, Knowlhill, Milton Keynes, MK5 8NG.

Tel: 01908 442291; Fax: 0870 0529193; Email: enquiries@pv-uk.org.uk

Web site: www.pv-uk.org.uk

Parliamentary Renewable and Sustainable Energy Group, 145, Fourth Floor, 35/37 Grosvenor Gardens, London, SW1W 0BS.

Tel: +44 (0)207 233 5887; Fax: +44 (0)207 630 9122

e-mail: info@praseg.org.uk; Web site: http://www.praseg.org.uk/

Hold a yearly one-day conference, usually in June/July.

UK research establishments specialising in renewable energy policy

Imperial College Centre for Energy Policy and Technology (ICCEPT)

Dept of Environmental Science and Technology, 4th Floor, RSM, Prince Consort Road, London SW7 2BP, UK.

Tel: +44 (0)20 7594 9324; Fax: +44 (0)20 7594 9334

e-mail: iccept@ic.ac.uk Web site: http://www.iccept.ic.ac.uk

Energy and Environment Research Unit (EERU), Pentz Building, Open University, Walton Hall, Milton Keynes, Bucks, MN7 6AA.

Tel: +44 (0)1908 653335; Fax: +44(0)1908 858407; Web site: http://eeru.open.ac.uk/

Other bodies relevant to UK renewable energy policy

The Carbon Trust, 9th Floor, 3 Clement’s Inn, London WC2A 2AZ.

Tel: 020 7170 7000; Fax: 020 7170 7020; e-mail: info@thecarbontrust.co.uk

Web site: http://www.thecarbontrust.co.uk

Department of Trade and Industry (DTI)

http://www.dti.gov.uk/renewable/

A range of documents relevant to UK renewable energy policy can also be found at http://www.dti.gov.uk/industries—energy.html

References

[1] Risø. Wind Resources Over Land. Denmark: Risø National Laboratory, 2000.

[2] Elliott D. Renewable energy R&D in the UK: a strategic overview. Technology Analysis & Strategic Management 1989;1(2):223–37.

[3] Elliott D. Renewable energy policy in the UK: problems and opportunities. World Renewable Energy Congress, Florence, Italy, 1996.

[4] TERES. The European Renewable Energy Study. Luxembourg, Advisory Council on Research and Development, European Commission, 1994.

[5a] Smith A Watson J The challenge for tradable green certificates in the UK. Successfully Promoting Renewable Energy Sources in Europe, Budapest, Hungary, 2002.

[5b] Smith A Watson J The renewables obligation: can it deliver? Brighton, SPRU, University of Sussex, 2002, 6.

[6] UK Department of Energy. Energy Paper 55 Renewable Energy In the UK: The Way Forward. London: HMSO, 1988, 11.

[7] DTI. Energy paper 62 New and renewable energy: future prospects for the UK. London: HMSO, 1994.

[8] DTI. The renewables obligation preliminary consultation. London: HMSO, 2000, p. 58.

[9] DOE-UK. This common inheritance: Britain's environmental strategy. London: HMSO, 1990.

[10] DOE-UK. This common inheritance: third year report. London: HMSO, 1993.

[11] DTI. Renewables obligation statutory consultation. London: DTI, 2001, p. 45.

[12] PIU. The Energy Review. London: Performance Innovation Unit, 2002, p. 218.

[13] ETSU. Strategic review of renewable energy technologies. London: HMSO, 1982.

[14] House of Commons: Select Committee on Science and Technology. Seventh report: wave and tidal energy. London: House of Commons, 2001.

[15] Mitchell C. The Renewables NFFO: A Review. Energy Policy 1995;23(12):1077–91.

[16] DTI. New and renewable energy: prospects for the 21st century. Conclusions in response to the public consultation. London: HMSO, 2000, p. 21.

[17] Rader NA, Norgaard RB. Efficiency and Sustainability in Restructured Electricity Markets: The Renewables Portfolio Standard. The Electricity Journal 1996;July:37–49.

[18] Halsbury's Statues, 4th Edition, Volume 17. London; Butterworth, 1995.

[19a] DTI. Renewables funding. Aberdeen: Renewables UK, 2002.

[19b] DTI. Wilson gives boost to wave power, London: DTI, 2002.

[20] Oxera Environmental. Regional Renewable Energy Assessments. London: HMSO, 2002.

[21] Blair T. Richer and Greener. CBI/Green alliance conference on the environment, London: UK Government, 2000.

[22] Delay T. Personal communication, 2002.

[23] Shortt P. Personal communication, 2002.

[24] Mitchell C. The England and Wales Non-Fossil Fuel Obligation: History and Lessons. Annual Review of Energy and the Environment 2000;25:285–312.

[25] EGWG. The embedded generation working group report into network access issues. London: TSO, 2001.

[26] Watson J. Renewables and CHP deployment in the UK to 2020, Tyndall Centre for Climate Change Research, 2002.

[27] Scottish Executive. Brankin Announces Support for Power from the Oceans, Scottish Executive. 2001.